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Meteorology

3711 Chemical composition and chemical interactions
ROCKET MEASUREMENTS OF THE DISTRIBUTION OF WATER VAPOR IN THE STRATOSPHERE AT HIGH LATITUDES
E.G. O'Brien and W.F.J. Evans, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario. M3H 5T4

Two measurements of the altitude distribution of stratospheric water vapor have been made with a rocket-borne infra-red photometer which measures long path atmospheric absorption of the solar beam in the 2.1 μm spectral region. The photometer was flown from Cape Parry, Canada (latitude 70.1°N, longitude 124.6°W), on December 6, 1975, and from Kiruna, Sweden (latitude 67.9°N, longitude 21.1°E), on March 11, 1975, at sunset. These measurements indicate that the water vapor mixing ratio increases from approximately 1.5 ppmv at the tropopause to approximately 6 ppmv at 30 km and then decreases at higher altitudes. These features are consistent with current theoretical considerations of the stratospheric water vapor distribution and with the results of other experimental investigations. A source region from methane oxidation at higher altitudes and a sink near the tropopause are suggested. A computer simulation of laboratory measurements indicated that the wings of the water vapor lines in the 2.1 μm region are super-Lorentzian. This super-Lorentzian behaviour of the line wings was incorporated in the analysis of the atmospheric measurements.
J. Geophys. Res., Green, Paper 1C0860

3715 Chemical composition and chemical interactions
THE PH OF HAWAIIAN PRECIPITATON A PRELIMINARY REPORT
J. M. Miller (NOAA-Air Resources Laboratories, Silver Spring, Maryland 20910)
A. M. Yoshinaga (NOAA-Mauna Loa Observatory, Hilo, Hawaii 96720).

Daily or biweekly precipitation samples have been collected at various sites on the island of Hawaii since 1975. The elevations of the sites ranged from sea level to 3400 m. Samples were analyzed on the day of collection for pH and conductivity. Detection of major anions, such as sulfate and nitrate, were made on selected samples during the period. The pH data show a progressive increase of acidity with elevation. The sea level site averaged pH 5.1, in contrast to the sites above 2500 m, which averaged pH 4.3. It is postulated that the increase in acidity at higher levels might be explained by acidic materials, either natural or man-made, being transported over long distances in the mid-troposphere and being scavenged in the rain of the Hawaiian islands. (Precipitation, chemistry, acid rain, long-range transport.)
Geophys. Res. Lett., Paper 1L0831

3719 Chemical composition and chemical interactions
THE ANNUAL VARIATION OF ATMOSPHERIC CO_2 CONCENTRATION OBSERVED IN THE NORTHERN HEMISPHERE
G.I. Pearman (CSIRO Division of Atmospheric Physics, P.O. Box 77, Mordialloc, Victoria, Australia 3195) and P. Hyson
[illegible]

for the separation of several possible causes of amplitude change. However, if the change is interpreted as reflecting enhanced biospheric growth, the effect is equivalent to a 6% change in the net uptake of carbon over the years 1959 to 1978 and to a growth of the northern hemisphere seasonal biosphere of 0.5×10^{12} kg of carbon per year. Such a conclusion is consistent with recent inventory studies which indicate that temperate zone forests have acted as a net sink of $\sim 10^{12}$ kg of carbon per year in recent decades. (CO_2, annual cycle, secular change, carbon cycle).
J. Geophys. Res., Green, Paper 1C0926

3715 Chemical composition and chemical interactions
SIMULATION OF NITROGEN CONSTITUENT MEASUREMENTS FROM THE AUGUST 26, 1976 STRATOPROBE III FLIGHT
W.F.J. Evans, C.T. McElroy, J.B. Kerr, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4
J.C. McConnell, CRESS, York University, 4700 Keele Street, Downsview, Ontario, M3J 1P4

A simulation of the altitude distributions of HNO_3, NO_2 and NO measured on the STRATOPROBE balloon flight of August 26, 1976 has been carried out using a time dependent stratospheric model with extensive photochemistry. The measured ozone and temperature profiles were employed in the simulation. The simulated ratios for HNO_3/NO_2 and HNO_3/NO are significantly larger than the measured ratios for HNO_3/NO_2 and HNO_3/NO in the altitude range 20 to 30 km. Since these ratios are proportional to the hydroxyl densities, it is proposed that the actual hydroxyl densities are a factor of 3 to 8 lower than calculated in the model using current chemical rate data. By assigning a pressure dependence to the $OH + NO_2$ reaction rate as well as including the $OH + HNO_3$ reaction rate in order to reduce the OH densities in the model over this altitude range, an empirical simulation of the measured ratios was obtained. The pressure dependence chosen for the rate was such that reasonable agreement with existing measurements of hydroxyl densities at higher altitudes was still obtained.
J. Geophys. Res., Green, Paper 1C0910

3720 Climatology
LONG-TERM VARIATIONS IN THE STRATOSPHERE OF THE NORTHERN HEMISPHERE DURING THE LAST TWO SUNSPOT CYCLES
K. Neujokat (Institut für Meteorologie, Freie Universität Berlin, 1000 Berlin 33, Federal Republic of Germany)
[illegible]

3735 Electrical Phenomena
BALLOON BORNE MEASUREMENTS OF ELECTRICAL CONDUCTIVITY, MOBILITY AND THE RECOMBINATION COEFFICIENT.
J. M. Rosen (Dept. of Physics and Astronomy, University of Wyoming, Laramie, Wyo. 82071) and D. J. Hofmann.

Balloon borne measurements of the positive polar conductivity (σ_+) from near ground level to 35 km are presented. The data were obtained in conjunction with previously reported measurements of the ionization rate (q) and the positive ion density (n_+). These three parameters are used to calculate the average positive ion mobility profile and the effective recombination coefficient profile. Within the experimental accuracy (±20%) the reduced mobility is constant with altitude at a value of about 1.6×10^{-4} m²-volt^{-1}-sec^{-1}. The recombination coefficient profile compares favorably to possible theoretical predictions but there is some serious question as to whether the theoretical values can in fact be compared directly to the experimental results obtained here.
J. Geophys. Res., Green, Paper 1C0734

3711 Electrical phenomena
DIRECT MEASUREMENT OF LOWER ATMOSPHERIC VERTICAL POTENTIAL DIFFERENCES
R. H. Holzworth (Space Sciences Laboratory, The Aerospace Corporation, P. O. Box 92957, Los Angeles, CA 90009; M. H. Dazey, E. R. Schnauss and O. Youngbluth

A high impedance system has been developed to make direct measurements of the atmospheric potential difference up to several thousand feet. A tethered balloon flown from Wallops Island, Virginia was used to loft a high voltage, insulated wire and a conducting collector to a final flight to 1800 feet for two days of experiments in October 1980. The balloon was equipped with a payload to measure exact altitude, wind speed and direction, and other meteorological parameters. Electric potentials of 170,000 volts at 1800 feet were measured. The short circuit currents which could be drawn through the wire were in the 10 microamp range and the impedance of the system was measured to be about 10^{10} ohms. This paper will describe the apparatus and details of these measurements. (Atmospheric potential, tethered balloon).
Geophys. Res. Lett., Paper 1L0721

3725 Electrical phenomena
[illegible]

Considerations in the Development of a National Geophysical Data Policy

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Introduction

Science emerged when it became apparent that the images of the world and of environmental events, acquired through the senses and registered by the human brain in natural day-to-day experience, contained inaccuracies and subjective biases that interfered with the development of an increasingly complex society. Recognition of the need for systematic statistical verification of predictions and for unbiased reporting and recording of both successes and failures of predictions became the fundamental driving force in the development of the scientific method and scientific thought. It became apparent that in order to establish a repertoire of reliable information on cause-and-effect relationships, environmental exploration and documentation would have to be expanded from subjectively 'relevant' phenomena to others that bore no direct relation to, or had no effect on, the human organism. It was also realized that a merely passive, qualitative, random observation of environmental events did not yield sufficient information. Active, quantitative probing and systematically planned experimentation became a necessity; the empirical method was born. Our sensory systems needed extension to achieve higher accuracy in the acquisition of environmental information, and scientific instruments were developed to make the measurements required for a quantitative description of environmental events over a wide range of domains. Finally, it was realized that the use of exo-ontological documentation, data, and information systems (books, data repositories, computers, etc.) was essential for organizing experimental paradigms, for their statistical interpretation, for recording results, and, in general, for the development of an 'objective truth' about environmental events.

Since the end of World War II, human society in most advanced countries has undergone a profound transition from an 'industrial society' to an 'information society.' In which industrial, economic, and military power is conditioned to information-processing power, and societal well-being, social organization, and government are conditioned to the information transfer capacity among elements of the population. *Bell* [1973] and many others have described this transition.

Research and development in an information society is heavily problem oriented, with the basic ethic of 'solving society's problems.' A recent *Arthur D. Little Inc.* [1978] report described this period as the 'problem-oriented Era III.' Initially, in the 'discipline-oriented Era I,' basic research and discipline-centered R&D were the main sources of new knowledge. Era I, however, persists, i.e., must persist, into Era III, for it provides the building stones on which problem-oriented information systems are to be built. The transition period, during the 1950's through the mid-1960's, has been called the 'mission-oriented Era II,' the basic ethic of which was to 'organize to do a job,' with data-intensive research efforts. Mission-oriented endeavors must also subsist into Era III.

Era I information systems mainly handle 'end products' of research (such as, articles, books, etc.); producers and users of information normally belong to the same discipline, and producers and users of raw data often belong to the same research group. In contrast, Era III information systems will mainly handle cross-disciplinary data flow (often intensive raw data flow) and deal with cooperative data analyses, which will become fundamental tools in the search for answers to the problems posed. Data producers and users usually belong to different groups and even to different disciplines, but they must be able to communicate with each other and work together in data analysis. The data needed are often of synoptic type, acquired in large monitoring networks, observatories, laboratory facilities, or based on large-scale statistics or surveys that cannot be operated or conducted by individual groups or institutes.

Today, research and development is becoming increasingly dependent on the availability of huge amounts of data and information stored in public repositories (data centers, technical libraries) accessible to users other than the originators. Yet the organization of data flow into and out of repositories has so far followed mostly 'local' or disciplinary Era I or II needs, evolving as those needs arose, with little national and interdisciplinary coordination. Even within the disciplines, there exist only a few formal agreements, on the part of certain data originators, regarding formats, units, and type of data to be stored. In summary, a full transition to Era III information systems has not yet taken place.

The Arthur D. Little report identifies nine problem categories as fundamental targets in Era III: environment, energy, economic well-being, safety, public health, transportation, crime prevention and administration of justice, housing, and welfare. Three broad scientific disciplines must cooperate in this endeavor, namely earth sciences, life sciences, and social sciences. Each one must develop Era III data and information systems which ultimately will provide, collectively, the quantitative answers sought for the problem categories above. Geophysics is now ready for the establishment of Era III-type data repositories. Indeed, large international programs such as the International Geophysical Year have contributed to a 'data explosion,' which has continued gathering momentum exponentially ever since. Hence geophysics should serve as a convenient proving ground for the testing and establishment of a national data policy appropriately tuned to the needs of tomorrow's society.

Data vs. Information

We usually think of the concept 'data' as embodying sets of numbers given in some digital or analog representation, encoding the values of some physical magnitude measured by a certain device under certain circumstances. And we usually think of the concept 'information' as embodying statements that represent answers to preformulated questions or that describe outcomes of expected alternatives. Data are meaningless without the knowledge of what physical magnitude they represent; the units, codes, and software used; and the particular circumstances of their acquisition. Information is meaningless without knowledge of the questions or alternatives that it is supposed to resolve.

Information is extracted from data whenever the data are subjected to some mathematical treatment that leads to the answer of preformulated questions. A remote sensing satellite picture is nothing but a collection of data representing light emission intensities in a two-dimensional array of solid-angle pixels. Information is extracted from that data only when a given pattern is searched for by an automatic device or by a human being looking at the picture and letting the brain recognize the pattern in question. A tape recording of magnetospheric VLF waves is nothing but a collection of data representing electromagnetic wave intensities in a given frequency band as a function of time. Information is extracted when the record is, say, Fourier-analyzed, or when it is played through an audio amplifier into a human ear and the pattern of perceived tones is recognized by the brain.

In the two above examples, the data appear in or have been converted into the form of sensorially detectable signals, with the human cognitive apparatus—the brain—effecting the information extraction. It is, however, of fundamental importance to realize that, ultimately, information extraction from any kind of data must engage the human brain at some stage. If not in the actual process of information extraction—pattern recognition in the above examples—the brain is engaged in the formulation of the alternatives or questions to which the information to be extracted refers. And it is also of fundamental importance to realize that, ultimately, information extraction always implies a process of pattern recognition at some stage, because questions and/or alternatives translate into patterns of parameter values—the data—that need to be searched for and recognized in order to obtain the answers the information conveys. For instance, the questions 'Is there a forest fire,' 'Is there a drought' translate into a set of patterns that need to be searched for and recognized in looking at, or scanning, a LANDSAT image; the question 'Is there a whistler' translates into a certain pattern of intensity versus frequency and time that needs to be recognized by listening to, or Fourier-analyzing, a VLF record. All this of course also applies to information extraction from data that have no relation to sensorially detectable magnitudes. The answer to the question 'was there a magnetic storm' requires pattern recognition in plots of geomagnetic data. Quite generally, we may assert that information only becomes information when it is recognized as such by the brain [*Roederer*, 1978]. Data will remain data, whether we use them or not.

Yet, what is one person's information may well be another person's data. Information itself is almost always expressible in a quantitative form and can become data out of which information of a higher level can be extracted. One thus obtains the hierarchical chains of information-extraction processes common to practically all research endeavours. An example is the conversion of raw or 'level I' data, such as the output signals of a detector, to level II data, which usually represent the values of a physical magnitude or parameter as determined by some algorithm applied to level I data. A thermographic record or a LANDSAT image are examples of level II data. Similarly, level III data are obtained by processing level II data (mostly from multiple data suites) with the use of mathematical models so that information can be extracted on the global physical behavior of the system under observation. A weather map is a typical example of level III data.

Data are acquired, transduced, transmitted, compressed, and/or integrated, stored, and retrieved. In each process there is a potential loss of information content through the introduction of noise and the involuntary or deliberate destruction of data. Information theory provides a framework with which involuntary random perturbations can be treated quantitatively. Deliberate destruction of data, particularly in data compression or integration processes (e.g., data averaging or conversion of multiple concurrent data suites into single-parameter values, respectively) is in itself an information-extraction process in which the resulting information (e.g., the average value or the value of a given function of the original data) automatically becomes data.

Data Infrastructure and Management Issues

Data storage—whatever the level of the data stored—necessitates the concomitant storage of information on the underlying data infrastructure, that is, information on the original physical magnitude(s) measured, on the circumstances of the measurement, on format and units, and on the software, assumptions, models, etc. used in the data-processing stages. Without such information, the stored data is worthless. For level I data, such information is usually available only to the experimenter. Once that information is lost, raw data become worthless. For level II data, much less concurrent information is necessary. Often it is enough to know to what physical magnitude they pertain, what the units are, and in what way the data suite is ordered (e.g., as a function of time, as a function of position, etc.). Level II data can be used by 'secondary' users, provided, however, that there is *confidence* in the data originators. If for some reason that confidence or credibility is lost, level II data become worthless. Essentially the same applies to level III data.

There are branches of physics in which the secondary user (a user that does not belong to the group that acquired the raw data) only needs level III data. These are branches in which the *reproducibility* of raw data can be easily, though perhaps not inexpensively, tested. Reproducibility is usually used to increase the statistics, i.e., to increase the statistical credibility or quality of the data. For instance, in elementary particle physics differential cross-section values for a given process usually are the only kind of

Fig. 1. Contributing to the geophysical data explosion. Soviet spacecraft assembly *Soyuz-22* before launch. This mission, flown in September 1976, provided massive remote sensing data obtained with photographic systems that included a Leitz (Jena) MKF-6 multispectral camera covering the range 4800–8400 Å (installed in the top compartment of the spacecraft assembly shown in the figure). The remote sensing project, named 'Raduga,' was conducted jointly by the USSR and the German Democratic Republic as part of the Interkosmos program.

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Cover. 1981 William Bowie Medalist Herbert Friedman in front of a rubbing of the Bowie Medal (see page 574).

data of interest to the secondary user. Raw data or level II data (e.g., actual counting rates in solid angle and energy intervals obtained with the experimental device) are seldom used by such secondary users and are often discarded by the experimenters after publication of the level III 'end product.'

In geophysics, however, data on natural phenomena are often 'unique' in that a given natural event seldom repeats under exactly the same circumstances. Thus when it comes to data storage, especially for studies in which the quest for predictability of natural events is the goal or in which data involve 'once in a lifetime' measurements such as obtained during a planetary flyby or a volcanic eruption, level II, or often even level I, data must be stored and remain available to secondary users. It is in these cases where the concomitant storage of information on data infrastructure is absolutely necessary in order to validate the data stored. Confidence, reproducibility, and quality of data are interconnected concepts. Documentation on data infrastructure, directly or indirectly, provides information on the quality of stored data. Since stored data must be retrievable to be of any value at all, catalogs and information on the data storage per se, its format, address map and access routes, expected deterioration processes, etc., are essential components of the data infrastructure.

As a result of the 'data explosion,' the need to retain ever-increasing amounts of geophysical data poses several major problems. One is given by the physical limits of storage and the decision-making processes on what to discard, what to retain, and for how long; others are related to data retrieval mechanisms.

The first problem may fade when new, revolutionary data storage techniques become commercially available, as is expected to happen during the next decade. However, an ultimate limit (at least to storage density) will always remain, determined by the effects of natural radiation damage to the information storage elements. Redundancy of addressed memory storage or implementation of holologic modes of storage will be required to mitigate this natural deterioration. Another major related question is that of the protection of the entire bulk of data from massive destruction by humans and natural catastrophes.

A formidable problem will ensue with the transcription of data stored on old systems to the new ones and with the required decision-making procedures on what to transcribe, what to leave on old systems running in parallel and for how long, and what to destroy.

As the storage capability increases, the problems with data retrieval will increase concomitantly. Again, new modes of storage and retrieval will become an absolute necessity. Here, another natural limit enters the picture, given by the finite velocity (c) of transmission of information inside the memory systems. Finally, if data storage capability increases drastically, the required decision-making processes may make data elimination more expensive than their retention; it is of course impossible at this time to predict future cost-effectiveness of one alternative versus the other.

The cost-effectiveness of data and information systems is mainly determined by the man-hours required for their operation; the energy expended during usage plays only a minor role. Furthermore, human error is the most important source of unreliability. It is thus very important to maximize automation and minimize human participation in the operation of data and information systems. There are however, two areas where it is impossible to eliminate completely the intervention of the human cognitive apparatus in the information-extraction process. It intervenes directly or indirectly via the formulation of physical theories and models and in the decision-making processes required for data formatting, retention, compression, and processing, which all must be based on the knowledge or anticipation of the kind of information that is to be extracted from the data. It also intervenes in the identification of the patterns in the data whose recognition leads to the information sought.

Toward a National Geophysical Data Policy

Increasingly, geophysical data sets have become larger and more complex to solve current scientific problems. Notable examples of disciplines that have been caught up in the data explosion are atmospheric sciences, seismology, magnetospheric physics, and satellite remote sensing (Figure 1). The resulting stress upon the geophysical sciences imposed by data requirements and management is already leading to a decreased effectiveness in solving both scientific and societal problems.

A national geophysical data policy is necessary in order to assure the availability, in adequate format and quality and at a rate commensurate with need, of information on the physical environment, the bounty it offers, the hazards it poses, and on the ways it is affected by human activities. A national policy must establish *regulations* for the management of data obtained by federal agencies or by others through federal support, it must set *guidelines* for data that are of national interest, and it must *promote* activities that will contribute to better geophysical data systems.

A data policy must address the following questions by regulating, setting guidelines, or promoting, as applicable:

1. What data should be deposited in national data repositories?
2. What information on data infrastructure, such as formats, the measuring devices, software, assumptions, possible error sources, data catalogs, etc., should be stored with the data?
3. Who decides on data formatting, data elimination, data compression, and data manipulation in general?
4. Who will check on data reliability and quality, and according to what criteria will this be done?
5. Who determines which data are of national interest?
6. For how long should data obtained with federal support remain proprietary with the originators, and how should these be credited by secondary users?
7. Which organizations should operate and/or establish the national data repositories?
8. What kind of data protection systems should be set up?
9. How will the scientific value or the market value of data be determined?
10. In case of the need to limit accessibility, how will users be afforded authorization that is based on a judgment of their needs and their ability to use and analyze the data?
11. Should users control or influence the organization and operation of national data repositories, and if so, how?
12. Should repositories be 'passive' archives, or should they also provide facilities for individual and cooperative computer-interactive data analyses?
13. Should data regulations be enforced directly by the agencies or funding agencies through which the data are provided?
14. To what extent should the entity coordinating the national data policy also deal with the promotion of collateral activities such as the development of new data systems, new techniques of storage and recall, related educational programs, etc.?
15. How should a national data policy be interfaced with proprietary data systems from the private sector and with data systems in other countries?

A study on Geophysical Data and Public Policy, chaired by Mike Chinnery of the MIT Lincoln Laboratory, is presently being conducted by the Committee on Geophysical Data of the Geophysics Research Board, National Academy of Sciences. The specific charge is (1) to ascertain, in persuasive terms to the scientific community and to those concerned with the generation and management of data, why there should be a national geophysical data policy; and (2) to lay out a plan to develop such a policy. A final report may be expected next year.

The recommendations of the study, if implemented, may have a profound effect on the future development of geophysics in our country.

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Juan G. Roederer holds a Ph.D. in physics (1952) from the University of Buenos Aires. Following professorships in Buenos Aires and at the University of Denver, he became director of the Geophysical Institute of the University of Alaska and dean of the College of Environmental Sciences. He is a fellow of the AGU and the AAAS, a member of the NAS Polar Research Board, past president of the International Association of Geomagnetism and Aeronomy, and was chairman of the International Magnetospheric Study Steering Committee. Before becoming a research administrator, his research activities focused on radiation belt physics and magnetospheric physics. He also conducted research on brain functions and wrote a book on psychophysics of music.

News

NSF Budget: A Separate Piece

In the final moments before packing up for the July 4 recess, the House of Representatives passed President Reagan's substitute budget proposal. However, a handwritten note, scribbled across one of the proposal's pages, removed the National Science Foundation's entire budget plus the research budgets for three federal agencies—including the National Oceanic and Atmospheric Administration—from the enacted legislation. The June 26 move appears to be a deliberate attempt by Republicans to shake loose the NSF budget from the omnibus budget bill so that NSF will require separate authorization.

The handwritten note called for striking a portion of the Reagan budget proposal and inserting different material, the *Washington Post* reported. Deletions included NSF's budget and the research budgets for NOAA, the Environmental Protection Agency, the Department of Energy, and the Federal Emergency Management Agency. A revised budget for DOE was reinserted.

NSF's budget will be considered as a separate bill, just as it has in previous years, according to Patricia E. Nicely, head of NSF's congressional liaison office.

Rep. Don Fuqua (D-Fla.), chairman of the House Science and Technology Committee, reassured scientists concerned about the funding: 'This is no time for panic within the scientific community. The visibility which will now surround the nation's scientific program, in fact, will provide us with the opportunity to enlighten not only Congress but the nation as a whole of the value of a strong program of pure and applied research to achieving national goals in economics, health, communications, transportation, agriculture, and dozens of other fields.'

Nicely seems more concerned; she says there is a good chance that Republicans may try to reduce NSF funding when the authorization comes to the House floor.—*BTR*

Improved NOAA Satellite

A new environmental monitoring satellite is scheduled for launch this summer. It will provide improved sea surface temperature information, which is of growing significance to the fishing and marine transportation industries, weather forecasters, and others. The satellite, now designated NOAA-C but to become NOAA-7 once in orbit, will carry the most versatile scanning radiometer ever sent aloft in an environmental spacecraft. It will gather visual and infrared imagery and measurements in five spectral channels. The hardware and launch costs for NOAA-C are $15 million and $7.5 million, respectively.

Two earlier satellites in the TIROS-N series carried four-channel radiometers. One of them, NOAA-6, is still operational, while the other, TIROS-N, failed after operating for twice its design life of 14 months and was turned off on Feb. 27, 1981. The design life of NOAA-C is about 2 years.

The improved sea surface temperatures will be of special value to fishermen off the West Coast and in the Gulf of Alaska and to marine shipping companies in the Gulf of Mexico and along the East Coast.

Commercial fishermen in California, Oregon, Washington, and Alaska use sea surface temperature charts compiled from satellite infrared imagery and data to locate the most productive fishing grounds for those species that are water temperature sensitive. Catches of salmon, albacore, and herring have been improved and fuel costs reduced, many fishermen report.

Along the East Coast and in the Gulf of Mexico, shipping interests use charts showing the Gulf Stream and Gulf Loop Current, also derived from satellite observations. Oil tankers, tugs towing barges, and other vessels take advantage of, or avoid, the swifter currents, reducing transit time and saving fuel. One towing and transportation company operating 60 vessels in the Caribbean estimates fuel savings of 20% to 40% by incorporating the stream and loop current information into its fuel conservation program.

NOAA-C will also carry a joint Air Force-NASA experimental instrument aloft to monitor possible contamination of the environment in the immediate vicinity of the spacecraft that may result from its propulsion systems. Such contamination, if it exists, could degrade the performance of future instruments planned for launch aboard similar satellites.

In addition to imaging the earth and obtaining atmospheric soundings, the TIROS-N series satellites also collect environmental observations from remote data platforms—such readings as wave heights on the oceans, water levels in mountainous streams, tidal activity, and the like. These versatile spacecraft also monitor solar particle radiation in space in order to warn manned space missions and high-altitude commercial aircraft flights of potentially hazardous solar radiation activity.

Finally, NOAA-6 and its new space twin have a communications function, distributing unprocessed sensor data to Earth stations in more than 120 nations in real time as the spacecraft pass overhead. [NASA/NOAA release]

SEAN Special Report

Mt. St. Helens Volcano, Cascade Range, southern Washington, USA (46.20° N, 122.18° W). All times are local (GMT − 7 hours). Small steam explosions, some ejecting a little ash, occurred intermittently through May. Until about May 20, only very slow changes were noted in the position of the north crater rampart and in thrust faults surrounding the dome. Measurements May 27 showed an acceleration in the rate of deformation, and reoccupation of rampart stations June 5 showed outward movement of about 1 cm/day. The rate of rampart movement had increased to about 2 cm/day between June 11 and 15, and the south thrust fault (SE of the dome) moved 6.3 cm/day during the same period. Data telemetered May 29–June 9 by a newly installed bubble tiltmeter just NE of the dome showed substantial uplifts consistent with other deformation data. Between May 1 and 16, the 3-day moving average of SO_2 output decreased from 450 to 150 tons per day. This trend reversed in late May, with emission rates rising from 190 tons per day on May 22 to about 500 per day by June 11.

The U.S. Geological Survey (USGS) and the University of Washington Geophysics Program issued a joint advisory June 12 stating that an eruption, probably of the dome-building type, was likely to begin within the next 1–2 weeks if ground deformation and gas emission trends continued.

Seismicity began to increase during the evening of June 17, and by the afternoon of the 18th it had reached several events per hour. The events were impulsive and of higher frequency than those that had typically accompanied previous eruptive episodes, but they were centered directly beneath the crater within 1 km of the surface. Between 1600 and 1700 the seismicity changed in character to smaller, indistinct (nonimpulsive) events, and at about 1700 the direction of tilt recorded by the bubble tiltmeter reversed. These changes are interpreted by the USGS as probably marking the beginning of lava extrusion, but cloudy weather prevented confirmation. As many as 12 of the indistinct seismic events, sometimes merging into bursts of noise, occurred per hour until about midnight, when the character of seismicity changed again to more typical low-frequency events with emergent arrivals. At about the same time, deformation recorded by the bubble tiltmeter leveled out, perhaps marking the end of extrusion. Seismic events, some larger than those of the previous few hours, decreased gradually in number to only a few per day by June 22.

Poor weather prevented access to the crater until the afternoon of June 19, when geologists observed new lava originating from near the center of the preexisting dome. The new lava covered an area roughly 300 m in both N-S and E-W dimensions, overriding portions of lobes extruded in February and April and much of the talus at their margins. The June extrusion increased the height of the composite dome by around 50 m.

The rate of SO_2 emission continued to increase prior to the probable start of lava extrusion and remained at a high level through June 20 as degassing continued after the new lobe was emplaced.

Information contacts: Tom Casadevall, Dan Dzurisin, Chris Newhall, and Don Swanson, USGS Field Office, 301 E McLaughlin, Vancouver, Washington 98663; Christina Boyko, Steven Malone, Elliot Endo, and Craig Weaver, Graduate Program in Geophysics, University of Washington, Seattle, Washington 98195; Robert Tilling, USGS, Stop 906, National Center, Reston, Virginia 22092.

Winds Can Foretell Showers

Small-scale surface wind patterns may hold the key to predicting the kind of local showers that can surprise weather forecasters by forming without the usual early warning signs. A new prediction method being examined by NOAA is based on the fact that when moist, low-level winds converge over a specified area, the air has no place to go but up. Clouds and showers result.

The relationship between wind convergence and rainshowers has been recognized in a general way for years. But researchers recently had an opportunity to test this knowledge in an area surrounded by wind reporting stations. The research was conducted in southern Florida, in a 625-square-mile region with wind stations spaced about 4 miles apart around the perimeter. Researchers found that showers in the area were closely related to the surface winds measured along the area's perimeter.

Investigators are now attempting to apply the Florida findings, which work well with that region's slow-moving thunderstorms, to the faster-moving storms of the Illinois prairie. These are more typical of the thunderstorms that form over the continental United States. [Source: NOAA]

NOAA's Hydrolab Conducts Reef Studies

This summer, scuba-diving scientists operating from Hydrolab, NOAA's undersea laboratory, are carrying out four experiments aimed at producing better management of coral reefs and their fishery resources. Hydrolab is located at a depth of 50 feet, near the mouth of the Salt River, off St. Croix, U.S. Virgin Islands. The lab houses four scientists for up to 2 weeks at a time, permitting them to swim out into the water to conduct research. The projects make use of both the natural coral reef near Hydrolab and the nearby artificial reef constructed for comparison studies.

John Ogden of Fairleigh Dickinson University's West Indies Laboratory is heading a team that will implant ultrasonic tags under the skin of 40- to 50-lb parrotfish—a vegetarian species—to follow their meanderings as they forage the area for sea grass. Parrotfish are the chief catch in Virgin Island fish pots, so mapping their habits will lead to better management of resources in the nearly fished-out waters, Ogden said. His team includes scientists from the Bernice P. Bishop Museum of Honolulu, Hawaii, and the government of the U.S. Virgin Islands.

Les Kaufman and John Ebersole of the University of Massachusetts will try to determine whether colonization of a reef is chaotic and haphazard, as is commonly believed, or organized and predictable, as Kaufman surmises. They will compare fish inhabiting natural reefs with those in an artificial reef and study the body design and eating habits of reef fish to correlate them with the fish's range of activity. The results will be used to manage coral reefs for recreational diving.

Kaufman's project was inspired by research undertaken by M. L. Reaka of the University of Maryland. This summer she will be making her third study of factors affecting the way a reef is colonized. Invertebrates such as crab and shrimp, she believes, determine how many fish settle on a reef. They are the chief food source of carnivorous species. She baits artificial reefs with invertebrates that attract small fish, which in turn lure larger, commercially valuable species. One purpose of her research is to establish a reef construction model that will effectively attract the larger fish.

William McFarland of Cornell University will lead a team studying this fall of the early life stages of coral reef fish and aggression in young and adult fish. The team will examine the vision of larval fish in the open-water phase of their existence to determine their relative sensitivity to blue light. The team will also study otoliths—solid material in the fish's inner ear that is used for balance and hearing—to calculate how old the fish are when they settle on the reef. Edward B. Brothers, who will accompany McFarland, said that what the team will learn about the larval stage—the most critical period in a fish's life—can be used to increase the survival rate of commercially important species.

Hydrolab at present is the only undersea habitat operated by the United States. It was constructed in 1971 and bought by Perry Oceanographics, Inc., for studies off Florida and the Bahamas. NOAA purchased and refurbished it in 1978 and moved it to the St. Croix location. Fairleigh Dickinson's West Indies Laboratory operates it for NOAA. It is the first of a planned network of regional university-based undersea research facilities sponsored by NOAA. The second, the Hawaii Undersea Research Laboratory (HURL), was dedicated early in May and will shortly go into full operation. [Source: NOAA and West Indies Lab]

Aukland University Centenary

The University of Aukland in New Zealand will celebrate its centenary May 5–9, 1983. The Geology Department would like to hear from all former students to help plan the department celebrations. Write to Geology Department Centenary Celebrations, University of Aukland, Private Bag, Aukland, New Zealand.

Geophysicists

AGU members who recently received departmental meritorious service awards from the U.S. Geological Survey are *Russell H. Campbell, Solomon M. Lang, Eugene C. Robertson,* and *Donald M. Thomas.*

John Imbrie, the Henry L. Doherty Professor of Oceanography at Brown University, is a Prize Fellow of the John D. and Catherine T. MacArthur Foundation. The award, more than $50,000 annually for 5 years, carries no restrictions.

Laurence H. Nobles has been appointed vice president for administration and financial planning at Northwestern University. A member of the geology faculty, he has been dean of administration since 1972 and has served as acting and associate dean of the College of Arts and Sciences.

Claes G. H. Rooth is acting director of CIMAS, the Cooperative Institute for Marine and Atmospheric Studies, a research institute established in 1977 by NOAA and the University of Miami. He is a professor of meteorology and oceanography at the Rosenstiel School of Marine and Atmospheric Science. Rooth succeeds *Eric B. Kraus,* who retired in March.

Klaus Wyrtki, professor of oceanography at the University of Hawaii, will receive the Rosenstiel Award in Oceanographic Science for 1981 in recognition of his work on large-scale oceanographic programs. The award is accompanied by a medal and $5000. The Rosenstiel School of Marine and Atmospheric Science is part of the University of Miami in Florida.

Jule G. Charney, an AGU Fellow and retired professor and chairman of the meteorology department at the Massachusetts Institute of Technology, died June 16 in Boston. He was 64. A past president of AGU's Meteorology Section, Charney was the winner of AGU's Bowie Medal in 1976 for his contributions to weather predictions. A founder of the National Center for Atmospheric Research, he was also chairman of the National Academy of Sciences' committee for global atmospheric research from 1968 to 1971. He joined MIT in 1956. From 1948 until his appointment at MIT, Charney was director of the meteorological research group at the Institute for Advanced Study at Princeton University. There, he participated in pioneer work that used computers for weather prediction. Charney also taught physics and meteorology at the University of California at Los Angeles from 1942 to 1946 and was a research associate at the University of Chicago from 1946 to 1947.

New Publications

Earth and Cosmos

R. S. Kandel, Pergamon, New York, xii + 254 pp., 1980, $14.90.

Reviewed by Glenn Shaw

This small but potent book by Robert Kandel (of the National Center for Scientific Research in France) has as its main purpose to introduce the reader to the deep-seated connections between man and the universe. In this sense the book has an almost Zen-like ring; it adopts, ultimately, the paradigm of Mach's principle stating in essence that 'all is connected—all is one.' But the mystical ramifications are for the most part put aside as the author tackles the job of summarizing the entire field of geophysics, astrophysics, and cosmology! There is hardly a stone left unturned—or at least unmentioned—as the author romps freely through the cosmos. All is done in 254 pages, plus appendices and a general bibliography.

The book is written for the general reader, yet the author does a remarkably adept job of conveying complicated ideas clearly, succinctly, and without the mathematical abbreviation. Though almost every conceivable subject of astrophysics is covered, the author's major aim is to keep the story pointed back to home ground and particularly to the extremely interesting experiment we are engaged in at the moment, which is trying to operate the solar system's first technological society.

The first few chapters give a brief, but articulate, run through of the forces in nature, the atom, radiation, the discovery of the primeval fireball, the condensation of galaxies, and the evolutionary history and the eventual fate of stars. To spark things up, subjects like Olbar's paradox (misnamed, incidentally; it would be better to call it Halley's paradox), Eddington's semi-mystical numerology on the constants of nature, the arrow of time, and theories of the nature of space (Newton, Berkely, Einstein) are introduced, though obviously something has to be missing in such a short treatment. The reader will, perhaps, be stimulated to read further and deeper on some of the subjects: if so, the bibliography is admirably suited to get a person started.

A major theme of the book is that the climate of earth is sensitive to perturbation. Kandel isn't worried so much about next years' wheat crop; he is concerned more about whether we will be able to grow wheat anywhere if we maintain present ways. It gives one great cause for contemplation to realize that earth's precious oxygen is being reduced by the burning of fossil fuel; the buildup of CO_2 that comes about reminds us of the atmosphere of Venus and man may yet scorch his wings!

I cannot imagine that there is any geophysical scientist alive who would not enjoy sitting down for a few hours with this little cloth-bound book. There are areas, I suppose, where territorial claims will muddy the waters because, after all, to charge through the universe and its galaxies and particles in 200 plus pages is to slight each discipline in some way. But, overall, the story is coherent. This book deserves to be read; it tells a story worth knowing.

Glenn Shaw is with the Geophysical Institute, University of Alaska, Fairbanks, Alaska.

Correction

The Scientific Ideas of G. K. Gilbert: An Assessment on the Occasion of the Centennial of the United States Geological Survey (1879–1979), edited by Ellis L. Yochelson (see review in *Eos, 62* (22), June 2, 1981). May be ordered from the GSA, 3300 Penrose Place, Boulder, Colorado, 80301. The list price is $17.00. The GSA address was given incorrectly in the review.

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POSITIONS AVAILABLE

Utah State University. Rangeland modeler, non tenure research 2 years appointment in Boise Idaho. Interface hydrologic, vegetation, animal, insect, and economic submodels into a comprehensive model and coordinate submodel development. Ph.D. range science, watershed science or economics required. Related experience and knowledge necessary. Submit vitae, transcripts and three letters of recommendation by August 15, 1981 to Bruce Godfrey, UMC 35, Utah State University, Logan, Utah 84322.

An equal opportunity-affirmative action employer.

Geophysicist/Tectonophysicist. The Department of Geology and Geophysics at the University of Wyoming has a tenure track opening at the Associate Professor level for a geophysicist (tectonophysicist). An interest in velocity measurements and other physical properties of rocks is essential. Additional interest in crustal structure and plate tectonics is desirable. Applicant should be able to relate studies of physical properties to field relationships. Ph.D. required.

Applications will be accepted through July 15, 1981. Applicants should send a vita, including names of three references, to:
Professor R. S. Houston
Department of Geology and Geophysics
University of Wyoming
Laramie, Wyoming 82071

The University of Wyoming is an equal opportunity affirmative action employer.

Electron Microprobe Technical Specialist/University of Colorado. The department of Geological Sciences, University of Colorado, Boulder, seeks a person who will assume responsibility for the department's electron microprobe laboratory. Duties will include day-to-day operation of our MAC 400 microprobe equipped with a KEVEX EDS system, instruction of new operators, maintenance of the microprobe as well as other X-ray equipment within the Department, microprobe software and hardware development, and participation in research projects involving silicate, sulfide and oxide mineralogy. The job requires either a degree in electronic or electrical engineering, or two years of technical experience utilizing electronic instrumentation associated with an electron column instrument. An individual with an M.S. degree in Geology and microprobe experience will be considered highly desirable. Salary ranges from $20,000-$25,000 depending on experience. Please send, by August 15, letter of application and resume to Bruce Bedger, Personnel Department, University of Colorado, 1511 University Avenue, Boulder, CO 80309.

The University of Colorado is an equal opportunity/affirmative action employer.

Physical Oceanographer. A postdoctoral research position in physical oceanography is available at the University of North Carolina at Chapel Hill, to begin as early as August 1981. Ph.D.'s with background and interests in mesoscale Gulf Stream dynamics, geophysical fluid dynamics, or ocean acoustics are encouraged to apply. Initial appointment will be for one year with a possible continuation through a maximum of three years. Please send vitae and the names of three references to Professor John M. Bane, Marine Sciences Program, 12-5 Venable Hall 045A, University of North Carolina, Chapel Hill, North Carolina 27514.

The University of North Carolina is an affirmative action/equal opportunity employer.

Physical Oceanographer. The New Orleans OCS Office, Bureau of Land Management, is seeking qualified candidates for a staff oceanographer to supervise contracted marine environmental research. The primary areas of research will be physical oceanography and meteorology. Duties include: serving as a contracting officer's authorized representative, developing study plans and work statements, and advising management on matters within the candidate's area of expertise. Candidate should have a M.S., Ph.D. preferred. Grade level: GS-11 or GS-12, salary $22,486–$26,951. Responding to announcement no. WO-81-140, send a current SF-171 to arrive no later than July 21, 1981 to Personnel Services (934) U.S. Department of Interior Bureau of Land Management, 19th & C Streets, NW, Washington, D.C. 20240 or call in verbal application at 202-343-7645.

Research Position/Space Plasma Physics. Applications are invited for two possible research positions in the Department of Space Physics and Astronomy, Rice University.

One position involves work on a computer code for simulating the large-scale dynamics of the earth's ionosphere and magnetosphere, including computer simulation of specific events and comparison with ground and satellite data. Preference will be given to applicants having experience with space or laboratory plasma physics, and with large computations.

The second possible position involves analysis of data from Atmospheric Explorer and Dynamics Explorer spacecraft. Preference will be given to applicants having experience with space plasmas and with reduction of spacecraft data.

Title and salary for either position will be arranged, depending on experience. Please send resume and bibliography to R. A. Wolf or P. H. Reiff, Department of Space Physics and Astronomy, Rice University, Houston, TX 77001.

Rice University is an equal opportunity/affirmative action employer.

Igneous/Metamorphic Petrologist. Faculty position, 12-month, tenure track. Candidate expected to develop strong research program emphasizing the application of latest theoretical, experimental and geochemical methods to petrological problems, particularly those related to the formation of oceanic crust, islands, and/or volcanic arcs. Rank is Assistant/Associate Professor. Salary: $23,000–$33,000 commensurate with experience. Send resume and names of three references by 1 September 1981 to:
O. Ross Heath, Dean
School of Oceanography
Oregon State University
Corvallis, Oregon 97331

OSU is an affirmative action/equal opportunity employer.

Geohydrology/Geochemistry/Economic Geology. Applications are invited for a one year appointment effective August 19, 1981 to teach undergraduate courses in introductory geology and either geohydrology, geochemistry, or economic geology. Ph.D. preferred but will consider ABD. The position will be reannounced in September 1981 as a tenure track slot at the assistant professor level with teaching and research duties about 50/50. Applications including resumes and names of three references should be sent to W. D. Gosnold, Jr., Department of Geography-Geology, University of Nebraska at Omaha, Omaha NE 68182.

An AA/EO employer.

Faculty Position
Space Physics & Astronomy

The Department of Space Physics and Astronomy of Rice University expects to fill a regular faculty position beginning August 1982. Academic rank and tenure status will be determined on the basis of experience.

Preference will be given to experimentalists who are Principal Investigators for experiments on present or planned spacecraft missions. However, consideration will be given to other qualified candidates in the general areas of space physics, astrophysics, and atmospheric science.

Applicants should send resumes and bibliographies to

Professor A. J. Dessler
Chairman
Department of Space Physics and Astronomy
Rice University, Houston, TX 77001.

Rice University is an equal opportunity/affirmative action employer. No candidate is presently under consideration in advance of this notice.

Postdoctoral Position in Geochemistry/Cosmochemistry, University of Arizona. Applications are invited for a postdoctoral research associateship in the Lunar and Planetary Laboratory at the University of Arizona. The associate will collaborate with Dr. William V. Boynton in ongoing investigations of the refractory inclusions in carbonaceous chondrites. The selected applicant will have major responsibilities to conduct mineralogical investigations to supplement existing neutron activation analysis studies. Experience with an electron microprobe is essential; experience with neutron activation is desirable. Facilities include a fully automated SEM/microprobe, numerous gamma-ray detectors including a Compton-suppression spectrometer, several computers and a TRIGA reactor.

Applications, accompanied by a resume, statement of research interests, and complete bibliography, should be sent to Dr. William V. Boynton, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721. Letters of recommendation, directed as above, should be requested from at least three persons who are well acquainted with the applicant's accomplishments and potential. To receive full consideration, application materials should be received by August 31, 1981.

The University of Arizona is an equal opportunity affirmative action employer.

Polar Oceanographer/Sea Ice Dynamicist. A position is available under the Intergovernmental Personnel Act of 1970 for persons now employed by State/local government or in colleges and universities. This position is located within the Oceanic Processes Branch of the Environmental Observation Division of the Office of Space and Terrestrial Applications, NASA Headquarters. The position is for one year, with the possibility for renewal for an additional year. Pay will be at a level commensurate with experience, and will be established after a review of qualifications.

Candidates must have been employed by the university in a permanent position for at least 90 days or be a career employee of a State or local government. Candidates must also meet the Federal qualification standards for the position. These are as follows: a degree in an appropriate field of science, plus three years of progressively responsible experience in duties related to the position.

The individual will be responsible for planning, developing, and implementing a scientific research program in satellite remote sensing of oceanic processes in polar regions. A background in polar oceanography, sea ice dynamics, or a closely-related field is required; experience in remote sensing, although desirable, is not essential. A Ph.D. or equivalent training and experience is mandatory.

Interested parties should send a current resume to NASA Headquarters, Attn: Mrs. Catherine Zegowitz, Code EPM-3, Washington, D.C. 20546.

Selection for this position will be made from other eligible candidates without discrimination for any nonmerit reason such as race, color, religion, sex, national origin, politics, marital status, physical handicap, age, membership or nonmembership in an employee organization, or personal favoritism.

Scientist. Immediate opening for Scientist with experience in Lidar Analysis Techniques and Optics. Familiarity with Laser and Optics Instrumentation a plus. Candidate must possess a PhD in Atmospheric Science/Optics/Physics.

Send resumes to: Melba Houston, Technical Recruiter, Systems and Applied Sciences Corporation, 6811 Kenilworth Avenue, Riverdale, Maryland 20840.

An equal opportunity employer.

Physical Oceanographer/Geophysical Fluid Dynamicist

Areté Associates, a growing research firm, located in Southern California, engaged in theoretical and empirical physical oceanography, is offering permanent, full-time positions. Candidates require Ph.D. (or equivalent experience) in physical oceanography or geophysical fluid dynamics. Salaries are competitive and negotiable, based on qualifications. Areté offers a fringe benefit package of superior quality. Qualified candidates should send résumé, salary history, and list of professional references to:

Personnel Administrator
Areté Associates
P.O. Box 350
Encino, CA 91316

An equal opportunity employer M/F.

Assistant Professor/Department of Geology, University of Vermont. The Geology Department of the University of Vermont is recruiting for a tenure track position at the assistant professor level to begin September 1982. Field of specialization should complement existing faculty expertise in petrology, structure and regional geology. Applications are solicited in, but not restricted to, geophysics, igneous petrology/geochronology, hydrology/Pleistocene or economic geology. The successful candidate will be expected to develop a research program involving both graduate students (M.S.) and advanced undergraduates. Applications will be accepted until December 1981.

Candidates should send resume and arrange for three letters of reference to be sent to:
Dr. John C. Drake
Acting Chairman
Department of Geology
University of Vermont
Burlington, VT 05405

The University of Vermont is an equal opportunity/affirmative action employer.

Atmospheric Scientist/Group Head. Senior staff scientist position available immediately at the NAIC's Arecibo Observatory. The successful applicant will be appointed as Head of the Atmospheric Sciences Group and will be expected to lead that group and to perform independent research using the Arecibo facilities. A Ph.D. degree in atmospheric or physical sciences or radar engineering and a record of solid research accomplishments are required. Experience with radar studies of the stratosphere, mesosphere, and ionosphere or with HF modifications of the ionosphere is desirable. Salary open. Please send resume and names of at least three references to Dr. Harold D. Craft, Jr., Director, Arecibo Observatory, Space Sciences Building, Cornell University, Ithaca, New York 14853.

NAIC/Cornell University are EOE/AAE.

Research Position. Applications are invited for the position of research engineer. Applicants should have a M.S. in civil engineering or related sciences and two years of experience. Demonstrated research ability in the mathematical modeling of water quality and quantity systems with interest in salinity controls applications. Responsibilities include assisting and preparing proposals, conducting research, teaching, and conducting short courses. Salary ranges from $27,700 to $32,000 (12 month basis) commensurate with qualifications and experience. Send resume and names and addresses of three references to L. Douglas James, Director, Utah Water Research Laboratory, UMC 82, Utah State University, Logan, Utah 84322.

An affirmative action equal opportunity employer.

Faculty Position/Humboldt State University, Arcata, California. Applications are invited for a temporary appointment as lecturer equivalent to assistant professor in micropaleontology, paleontology, stratigraphy and petroleum geology in the geology program to teach undergraduates. Applicants should have a Ph.D. in geology and demonstrated teaching ability. Participation in lower division teaching and senior thesis research supervision is expected. Candidates must solicit three letters of recommendation, and send transcripts of academic work and a summary of personal and professional data to Dr. K. R. Aalto, Chairman, Geology Department, Humboldt State University, Arcata, California 95521. Applications will be accepted until October 15, 1981.

Humboldt State University is an equal opportunity affirmative action employer.

Geophysical Oceanography Postdoctoral Research Associate. The Department of Oceanography, University of Washington, is seeking qualified candidates for a Post-doctoral Research Associate position, available January 1982, to carry out research on interpretation of marine refraction data. A strong background in elastic wave propagation, inverse theory (including linear programming), and modern refraction data processing will be most helpful, as will an acquaintance with petrologic theories of oceanic lithospheric composition. Appointments are for one year, possibly extended for a second year. Send curriculum vitae and a list of four references to: Chairperson, Faculty Recruitment Committee, Department of Oceanography WB-10, University of Washington, Seattle, WA 98195.

The University of Washington is an equal opportunity/affirmative action employer.

Theoretical Oceanographer/Ocean Modeller. Will carry out independent research on problems of ocean dynamics with emphasis on the development and application of numerical models of large-scale ocean circulation. Requires background in physical oceanography/geophysical fluid dynamics equivalent to the Ph.D., and mathematical abilities for and experience in the development of numerical models of ocean circulation. This position is available about 1 September 1981. Please send vitae, publications list, salary history and requirements and 5 references to Margarets Domecki, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307.

NCAR is an equal opportunity/affirmative action employer.

Sedimentologist or Sedimentary Petrologist/University of California, Santa Barbara. (Correction) Applications are invited for a tenure track appointment in soft rock geology to be filled in 1981–82. Rank dependent on qualifications and experience but preference will be given to the assistant professor level. Applicant should normally have a Ph.D. and strong field-orientation and quantitative background. The candidate will be expected to develop a strong research program in sedimentation. The candidate will also be expected to teach at both undergraduate and graduate levels and interact with students and faculty of the department, particularly in the general areas of diagenesis, volcanic processes, paleomagnetics, as well as field geology. Additional duties may include teaching physical geology and summer field geology.

Please send resume, other documentation of abilities, and four letters of recommendation by September 30, 1981 to Dr. Arthur G. Sylvester, Chairman, Department of Geological Sciences, University of California, Santa Barbara, CA 93106. Telephone (805) 961-3156.

The University of California is an affirmative action/equal opportunity employer.

OUTSTANDING CAREER OPPORTUNITIES IN

IONOSPHERIC PHYSICS

Los Alamos National Laboratory is seeking two senior research scientists to participate in activities in ionospheric physics research in our Space Sciences Office. Both positions require a Ph.D. in physics, geophysics, space physics, related field or equivalent.

POSITION #1: Team member to employ active experiment techniques (rf heating, barium plasma injections, etc.) to probe ionospheric plasma (plasma transport, beam plasma interactions, plasma polarization-depolarization phenomena). Considerable effort on plasma phenomenology in association with upper atmospheric nuclear explosions. Requires demonstrated competence in theoretical plasma physics with training and experience in kinetic theory. Familiarity with ionospheric and/or magnetospheric physics desired.

POSITION #2: Chief theorist in a team designing, deploying, and modeling HF radar instruments which investigate the source and nature of disturbances of the neutral atmosphere in the region of the ionosphere. Investigate the mechanism for formation and propagation of acoustic-gravity waves in the atmosphere. Research will involve analytical and numerical investigations. Requires demonstrated competence in analytical and numerical fluid dynamics, preferably with experience in atmospheric physics and/or geophysics. Some experience in atmospheric effects of nuclear weapons helpful.

The Laboratory is a multi-faceted national R&D organization operated by the University of California for the Department of Energy. We provide excellent working conditions and benefits, such as 24 days' annual vacation. Our location in the mountains of northern New Mexico offers a pleasing lifestyle in a setting of great natural beauty: a pollution-free environment; ample recreational activities; casual, uncrowded living; an outstanding school system; and low taxes.

Send complete resume, in confidence, to:

James Trout, DIV 81-BV
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, New Mexico 87545

An Affirmative Action/Equal Opportunity Employer. Women, Minorities, Veterans and the Handicapped urged to apply. U.S. Citizenship Required.

Los Alamos National Laboratory
Los Alamos New Mexico 87545

Meteorologist/Remote Sensing. Immediate opening for candidate with a PhD in Meteorology with post graduate research experience and interest in Remote Sensing.

Send resumes to: Melba Houston, Technical Recruiter, Systems and Applied Sciences Corporation, 6811 Kenilworth Avenue, Riverdale, Maryland 20840.

An equal opportunity employer.

Position in Reflection Seismology/Rice University, Houston, Texas. The Department of Geology plans to expand its geophysical program. Emphasis will be on reflection seismology. At this time applications are for the first of two open faculty positions. The successful applicant will help in the search for and selection of the second faculty member.

Your main responsibility will be to lead our department into the area of modern reflection seismology. Your main teaching and research interests should be in the acquisition and processing of reflection seismic data. You should also help in developing rigorous undergraduate and graduate curricula, which are supported by the traditional strength of the Math Sciences, Physics, and Electrical Engineering Departments at Rice. Enthusiasm to work with and undertake some joint projects with our geologists is essential.

Our plans are to acquire a computer system configured for high quality data processing. Substantial seed money for this facility is already in hand. Creative cooperation with the oil and geophysical industry in Houston, including a reasonable amount of consulting, is encouraged. Salary will be commensurate with qualifications and experience. Please send your curriculum vitae, a summary of experience in seismic processing, a statement of research interests, and names of three or more references to Dr. A. W. Bally, Chairman, Department of Geology, Rice University, P.O. Box 1892, Houston, Texas 77001. Application deadline—October 1, 1981.

Rice is an equal opportunity employer.

SERVICES

Scripps Remote Sensing Tutorials.

1A. *Overview of the Remote Sensing Facility*—This one-day seminar describes the data bases, sources and processing capabilities available at Scripps Institution of Oceanography, Remote Sensing Facility. A morning lecture will introduce past, current and future space platforms available for observation of the Oceans. A brief discussion of where and how to access this information will conclude the first part of the class.

The afternoon will include a demonstration of processing and displaying imagery obtained from TIROS-N, NOAA-6 and NIMBUS-7.

Classes will be held at the Helen Raitt Room SIO Library on Monday, April 20, 1981 and Monday, July 27, 1981, at 9:30 am. A nonrefundable fee of $50.00 must be submitted with the application. Enrollment limit—12.

2A. *Users Introduction to the Scripps Remote Sensing Facility*—This four-day workshop is intended exclusively for individuals who will be using the facility at Scripps. Two morning lectures will describe in detail the hardware, software and personnal resources available to oceanographers. Existing data bases, their characteristics, location, mode and cost of access will be covered. Basics of image processing will be introduced along with in-depth look at the Interactive Digital Image Manipulation System used at the SRSF.

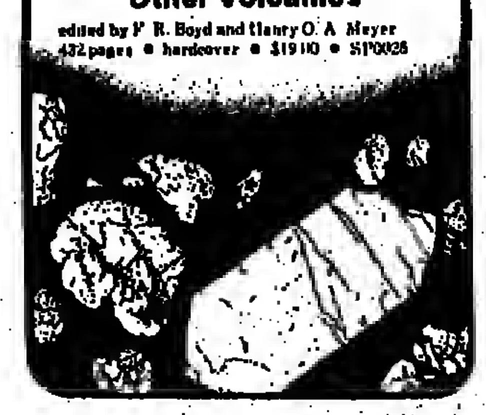
The two lectures will be followed by afternoon lab sessions which consist of hands-on exercises to familiarize users with the hardware software at the facility. The third morning will be devoted to train users in realtime spacecraft tracking and data recording and acquisition.

The remainder of the 3rd day and the entire 4th day will be used to work with users on a one-to-one basis. Attendees are encouraged to bring their own digital tapes with data of interest to them, which can be used during this last portion of the workshop.

Classes will be held in the Helen Raitt Room SIO Library starting on Tuesday, April 21, 1981 and Tuesday, July 27, 1981 at 9:30 am. A fee of $335.00 must be submitted with each application. Enrollment limit—6.

For more information regarding applications, fees, etc., please contact University of California at San Diego, SRSF-SIO, Mail Code A-030, La Jolla, California 92093 or (714) 452-2292.

Jet Stream. New journal of monthly world weather data and analysis. Sample from Westwind Services, c/o 2736 NW Quimby St. Portland, Oregon.



AGU

AGU Awards

Forty-third Presentation of the
William Bowie Medal
to
Herbert Friedman

for outstanding contributions to fundamental geophysics and for unselfish cooperation in research

Citation

Since the arrival of the space age, Herbert Friedman's whole life has been dedicated to the observation and interpretation of the space environment and its behavior. Thus, in 1949, when V-2 missiles were made available to American investigators, he began his experiments at the Naval Research Laboratory by adapting laboratory instruments to measure in space the solar ultraviolet and X ray light and its absorption in the high atmosphere. Then he went on to investigate the effect of the solar radiation on the ionosphere. His interest in space geophysics—the influence of sun on earth—has never flagged since. He has always shown superb judgment in choosing experiments which were both scientifically significant and achievable. Hence, he was led to pioneering discoveries in geophysical understanding.

Behind Herbert Friedman's leadership of the E. O. Hulburt Center for Space Research at the Naval Research Laboratory there developed a number of teams exploring sun, earth, and the interplanetary medium from space with discriminating understanding. He has encouraged them to collaborate so with outside scientific teams that now it is sometimes difficult to keep track of the myriad cooperative relationships. Moreover, in recent years he has continued to advance the cause of geophysical investigation, including especially the use of observations from space, through advocacy of support for fundamental space geophysical investigations as member and chairman of important scientific committees and commissions. As a publicist for good science and amiable expositor of space geophysics to the wider scientific and public communities, he is well known. In brief, he so well exemplifies one who has made 'outstanding contributions to fundamental geophysics' and [one] who stands for 'unselfish cooperation in research' that award of the William Bowie Medal to him is specially fitting. Thus he is a worthy and distinguished geophysicist who appropriately joins the lineage of previous Bowie Medal recipients renowned for their accomplishments and influence.

When, after some 9 years at the Naval Research Laboratory, Herbert Friedman turned from laboratory (X ray) research to space experiment, the initial rocket observations were of fundamental geophysical significance. Thus he conducted the first space observations of the role of solar X rays, Schumann-region ultraviolet, and Lyman alpha in the production of the ionosphere. He was principal contributor to the study of the relationship between solar flux variability and ionospheric behavior over a solar cycle (1949–60). He also was responsible for the theoretical prediction and first observations of the role of solar flare X rays in producing ionospheric fadeout. Next, the fundamental contribution of the first X ray/ultraviolet monitoring satellite—SOLRAD-1 (1960)—initiated the whole new age of space environment monitoring.

Then Friedman provided the first theoretical model of the *E* and *F* region ionosphere based on rocket observations of X rays, the extreme ultraviolet, and the dissociation of molecular oxygen in the high atmosphere. He first observed the ultraviolet airglow from rockets: the Lyman-alpha airglow of the high atmosphere was discovered; it revealed the hydrogen geocorona. He identified the Lyman-beta hydrogen glow of the night sky, principal input to support of the night-sky ionosphere in the *E* region. He provided the first X ray photograph of the sun and thus showed the relationship between X ray active regions and microwave radioheliograms.

In fostering unselfish cooperation in research, Herbert Friedman's contributions have been marked by knowledgeable and far-reaching vision and continuing diligence. He has been especially influential in developing international cooperative programs in solar-terrestrial research. He served as chairman of the Inter-Union Committee for Solar-Terrestrial Physics (IUCSTP) during the IQSY and was primarily instrumental in obtaining its conversion to the Special Committee for STP (SCOSTEP), which how has essentially permanent status in the International Council of Scientific Unions. He served as first president of SCOSTEP, 1966–74, and initiated the organization of the International Magnetospheric Study (IMS).

In recent years, Herbert Friedman has chaired the Geophysics Research Board (GRB), the Committee on Solar-Terrestrial Relationships (CSTR), and several studies under National Academy of Sciences/National Research Council auspices which have contributed to the health and development of the field of solar-terrestrial research. Through the years he played a key role in developing the scientific cooperative missions of the Committee on Space Research (COSPAR) as a member of the executive committee, 1961–75, and as vice-president, 1971–75.

Herbert Friedman is a multifaceted man (we neglect to talk of his proficiency in art and love for tennis and classical music) whose creative fundamental research and unswerving effort over a whole lifetime to foster cooperation in research are hardly adequately summarized by the outline sentences above. Nor have we referred to his service on editorial boards or to his role in publicizing and describing geophysics to a wider audience (he serves as editor and writer for the section 'Reviews of Space Science' in the AIAA journal *Astronautics and Aeronautics*). These activities, even if significant, are peripheral to the present comment. However, it is important to emphasize that united with his excellence and cooperative dedication in geophysical research is a personable demeanor which is forthright, understanding, and amiable, but persistent. Indeed Herb Friedman's approach to problems has always been never to give up on the important efforts but always to identify the simpler but most significant next step to take. That has led him to major geophysical research discoveries and the most valuable progress in cooperative ventures. Those are the core attributes of a Bowie medalist.

This citation was prepared by Phillip Mange and presented by Norman F. Ness.

Acceptance

William Bowie took a prominent part in shaping the destiny of the American Geophysical Union in its beginning. It was he who advocated enlarging the membership from committee size to a full-fledged scientific society, so that the original 50 members grew to our present AGU of 13,000. Described by his contemporaries as a man of the most inspiring presence and persuasion, he used his extraordinary talents to help create the International Union of Geodesy and Geophysics and set the course of international cooperation in geophysics for generations to follow. It is indeed an inspiration as well as a great honor to receive the Bowie Medal.

My scientific career began when William Bowie's ended. In these last 40 years, science has become the main cultural phenomenon of our time. It pleases me to discover that William Bowie was a member of the astronomy section of the National Academy of Sciences. In the grand unification of natural science today, all disciplines come together so that we have a 'melting pot' sociology of scientists in which physicists, geophysicists, and astrophysicists are amalgamated.

Cosmologists await the physicists' determination of the lifetime of the proton to decide on the symmetry of the universe. Solar-terrestrial physicists speculate on the connection between the missing solar neutrinos and the possible influence of the sun on climate.

The study of magnetospheres is bounded by scale sizes that range from the compact pulsars to the hundred-thousand light-year dimensions of head-tail galaxies. In between are the varied personalities of the solar system magnetospheres.

So sensitive are the techniques of radio interferometry and laser ranging that they measure the tiny slippage of continents—movements no faster than the growth of a fingernail. Incredibly, we detect starquakes of micron dimensions on neutron stars thousands of light-years distant.

How baffling is the ultimate puzzle of who we are, where we come from, and why we are here! Life's origins are entwined in the processes of molecule building in interstellar space, the role of exploding stars in triggering the condensation of primordial gas clouds, and the evolution of ecologically favorable life zones in planetary environments. The hot surface and murky atmosphere of Venus, the turbulent clouds of Jupiter, the rings of Saturn, the dead soil of Mars, and the dying whisper of microwaves left over from the Big Bang are parts of a cosmic tapestry in which we search for answers. How fortunate that we can pool our interdisciplinary talents to join this search.

William Bowie's spirit of scientific cooperation is more appropriate now than ever before.

Herbert Friedman

Meetings

Delegates to IUGG Association Meetings

U.S. scientists planning to attend the 21st General Assembly of the International Association of Seismology and Physics of the Earth's Interior (IASPEI), to be held in London, Ontario, July 30–31, 1981; the Fourth Scientific Assembly of the International Association of Geomagnetism and Aeronomy (IAGA), to be held August 3–15, 1981, in Edinburgh, Scotland; the Third Scientific Assembly of the International Association of Meteorological and Atmospheric Physics (IAMAP), to be held August 17–22, 1981, in Hamburg, Germany, should notify A. F. Spilhaus, Jr., Secretary of the U.S. National Committee for IUGG, 2000 Florida Avenue, N.W., Washington, D.C. 20009, so that they can be placed on the official list of delegates from the United States to these meetings.

1982 COSPAR Meeting

The first bulletin for the 24th plenary meeting and associated activities of COSPAR contains preliminary program plans for the symposia and workshops scheduled for the meeting, May 17–June 3, 1982, in Ottawa, Ontario, Canada. Information on travel, registration, and accommodations is also included. A second bulletin, to be published in September, will contain more detailed information.

Advance registration closes April 15, 1982, but applications for the limited funding available to participants are due February 15.

All correspondence for the meeting, including requests for the meeting bulletins, should be addressed to T. W. McGrath, Executive Member, Local Organizing Committee, XXIV COSPAR, Conference Secretariat, National Research Council, Ottawa, Ontario K1A 0R6, Canada (or telephone 613/993-0312).

FUTURE AGU MEETINGS

Chapman Conferences
Spatial Variability in Hydrologic Modeling
July 21–23, 1981, Colorado State University, Fort Collins, Colorado
Rainfall Rates
April 27–29, 1982, Illini Union, Urbana, Illinois

1981 Midwest Meeting
September 17–18, 1981, Radisson Hotel, Minneapolis, Minnesota

1981 Pacific Northwest Meeting
September 17–18, 1981, Central Washington University, Ellensburg, Washington

Ocean Sciences: AGU/ASLO (American Society of Limnology and Oceanography) Joint Meeting
February 16–19, 1982, St. Anthony Hotel, El Tropicano Hotel, Gunter Hotel, San Antonio, Texas

Fall Meetings
December 7–11, 1981, San Francisco
December 6–10, 1982, San Francisco
December 5–9, 1983, San Francisco

Spring Meetings
May 31–June 4, 1982, Philadelphia

Estuarine Conference Extended

The Sixth Estuarine Biennial Conference, originally scheduled for November 1–5 in Gleneden Beach, Ore., has been extended another day; the conference will end at noon, November 6, according to the latest update from the Estuarine Research Foundation, sponsor of the meeting. The large number of submitted papers caused the extension, said the foundation.

For additional information, contact Jay F. Watson, Treasurer, USFWS Suite 1692, 500 N.E. Multnomah Street, Portland, OR 92232.

Changes

The complete Geophysical Year last appeared in the June 23 *Eos*.

Boldface type indicates meetings sponsored or cosponsored by AGU.

1981

Aug. 17–22 **Ninth International Symposium on Earth Tides**, to be cosponsored by AGU.

Nov. 1–6 Sixth Biennial International Estuarine Research Conference, originally scheduled to end one day sooner; has been extended.

Dec. 3–5 **Topical Conference on the Processes of Planetary Rifting**, to be cosponsored by AGU.

1982

May 17–June 3 24th Plenary Meeting of COSPAR, start of meeting one week earlier and conclusion of meeting one day earlier than previously listed. New contact, T. W. McGrath, Executive Member, Local Organizing Committee, XXIV COSPAR, Conference Secretariat, National Research Council, Ottawa, Ontario K1A 0R6, Canada.

Aug. 22–28 **Third Circum-Pacific Energy and Mineral Resources Conference**, to be cosponsored by AGU.

Aug. 24–27 Ninth Annual Meeting of the European Geophysical Society, start of meeting one day later than previously listed.

New Listings

1981

Oct. 12–16 Third International Ocean Disposal Symposium, Woods Hole, Mass. Sponsor, Office of Marine Pollution Assessment, NOAA. (I. W. Duedall, Marine Sciences Research Center, State University of New York, Stony Brook, NY 11794.)

Oct. 29–31 28th Annual Eastern Pacific Oceanic Conference, Idlewood, Calif. (R. Michael Laurs, EPOC Secretary, Southwest Fisheries Center, NMFS, La Jolla, CA 92037.)

1982

May 23–28 Eastern Conference on Water and Energy: Technical and Policy Issues, Pittsburgh, Pa. Sponsors, ASCE, League of Women Voters, Council of State Governments. (F. Kilpatrick, USGS National Center, Mail Stop 414, Reston, VA 22092.)

June 27–30 Western Conference on Water and Energy: Technical and Policy Issues, Fort Collins, Colo. Sponsors, ASCE, League of Women Voters, Council of State Governments. (D. Metchell, Stone and Webster Engineering Corp., P.O. Box 5406, Denver, CO 80217.)

Sept. 3–11 Fourth World Congress on Water Resources, Buenos Aires, Argentina. Sponsor, International Water Resources Association. (G. E. Stout, President of the U.S. Geographical Committee, Water Resource Center, University of Illinois, 2535 Hydrosystems Laboratory, 208 N. Romine, Urbana, IL 61801.)

1983

Feb. 1–11 15th Pacific Science Congress, Dunedin, New Zealand. Sponsor, University of Otago. (Secretary-General, P.O. Box 6063, Dunedin, New Zealand.)

GAP

Geochemistry

1610 Chemistry of the atmosphere
A NEGATIVE FEEDBACK MECHANISM FOR THE LONG-TERM STABILIZATION OF EARTH'S SURFACE TEMPERATURE
J. C. G. Walker (Space Physics Research Laboratory, University of Michigan, Ann Arbor, MI 48109) P. B. Hays and J. F. Kasting
We suggest that the partial pressure of carbon dioxide in the atmosphere is buffered, over geological time scales, by a negative feedback mechanism in which the rate of weathering of silicate minerals (followed by deposition of carbonate minerals) depends on surface temperature, and surface temperature in turn, depends on carbon dioxide partial pressure through the greenhouse effect. Although the quantitative details of this mechanism are speculative, it appears potentially able to stabilize Earth's surface temperature against the steady increase in solar luminosity believed to have occurred since the origin of the solar system. (Carbon dioxide, paleoclimatology, paleoatmospheres).
J. Geophys. Res., Green, Paper 1C0947

1610 Chemistry of the atmosphere
ATMOSPHERIC METHANE (CH_4): TRENDS AND SEASONAL CYCLES
R. A. Rasmussen (Oregon Graduate Center, 19600 N.W. Walker Rd., Beaverton, OR 97006) & M. A. K. Khalil
Based on twenty-two months of almost continuous, automated, GC/FID measurements of atmospheric CH_4 at Cape Meares (45°N), we show that the concentration of CH_4 is increasing at about 2% per yr (±0.5% yr^{-1}). The data also revealed stable seasonal cycles with peak concentrations in October and minimum concentrations in July. The magnitude of the seasonal variations during those months is about 125 ppbv from the average (~±1.2%). If the current trend continues, the increased CH_4 concentration may result in a 0.2°K–0.4°K average increase in Earth's surface temperature over the next 40 years (based on calculations of Wang et al., 1976). The coupling of CH_4 to tropospheric and stratospheric chemical processes is discussed.
J. Geophys. Res., Green, Paper 1C0854

1620 Chemistry of bodies of water
INCREASING HYDROGEN ION ACTIVITY OF WATER IN TWO RESERVOIRS SUPPLYING THE SAN FRANCISCO BAY AREA, CALIFORNIA
J. E. McColl (Department of Plant and Soil Biology, 108 Hilgard Hall, University of California, Berkeley, CA 94720, USA)
The hydrogen ion activity (H^+) of water in two Sierra Nevada reservoirs (Pardee and Hetch Hetchy) that supply the San Francisco Bay area has been increasing with time over the period 1954 to 1979. This conclusion is based on weekly measurements of pH at the two reservoirs and is supported by measurements of alkalinity which decreased at Pardee over the period 1944 to 1979. Based on linear models, the rate of the increasing (H^+) was the same at both reservoirs, and (H^+) varied concomitantly from year to year, suggesting a common, general cause. Mean monthly variation in (H^+) corresponded to mean monthly variation in atmospheric pollution from a nine-county area around San Francisco Bay. The most likely cause of the increasing (H^+) of reservoir waters is NO_x from automobile exhaust primarily from the San Francisco Bay area. (Acid rain, air pollution, limnology, pH).
Water Resour. Res., Paper 1W0909

1620 Chemistry of bodies of water
GEOCHEMISTRY OF THE AMAZON 1. PRECIPITATION CHEMISTRY AND THE MARINE CONTRIBUTION TO THE DISSOLVED LOAD AT THE TIME OF PEAK DISCHARGE
R.F. Stallard (U.S.G.S. Office of Marine Geology, Woods Hole, MA 02543) and J.M. Edmond
Analyses of precipitation and surface water are used to estimate the fluxes of marine cyclic salts through that part of the Amazon River system draining past Obidos (80% of the basin) at the time of peak discharge in June. Amazon precipitation chemistry can be divided into two principal components, marine and terrestrial. The marine component (determined from analyses of marine rain) consists of Na, K, Mg, Ca, and Cl in approximately seasalt proportions, with S doubly enriched. The excess sulfur is probably derived from gas phase inputs. The terrestrial component makes an important contribution of K, Ca, S, and N, much of which can be related to biological emissions. The emission of reduced sulfur in the marine and terrestrial environment and nitrogen in the terrestrial environment is responsible for a natural "acid rain" in the Amazon region with a pH from 4.7–5.7. This is about one tenth the acidity of polluted urban rain. The chloride content of lowland rivers which drain regions lacking significant geologic sources of chloride, shows a systematic decrease in chloride with increasing distance from the ocean. This trend is used to define the cyclic salt background for Amazonian surface waters. Cyclic salts, in general, make only a minor contribution, relative to terrestrial inputs, to the chemistry of Amazon Basin rivers, even those draining intensely weathered terrains. An estimated 17.6%-Cl, 6.9%-Na, 1.3%-Mg, 3.6%-S, 0.4%-K, and 0.1%-Ca of the dissolved load at Obidos during peak discharge is cyclic. (Cyclic salts, precipitation chemistry, river chemistry, Amazon).
J. Geophys. Res., Green, Paper 1C0950

Hydrology

3130 Groundwater
MODELS OF WATER TRANSPORT IN THE SOIL-PLANT SYSTEM: A REVIEW
F. J. Molz (Civil Engineering Department, Auburn University, AL 36849)
Although the study of plants (botany) is one of the oldest sciences, relatively detailed quantitative theories of water transport in plant tissue have lagged behind those describing water transport in soils and other geologic materials which constitute the saturated and unsaturated zones. Many existing texts deal with various aspects of water transport in these earth materials, but little or nothing is devoted to the analogous transport of water in plant roots and tissue at a similar quantitative level. Yet the soil-root-stem water pathway is a major component of the subsurface hydrologic system. Evidently there is a need for both engineering and agricultural hydrologists to further develop their quantitative understanding of water movement in plant and soil-plant systems.
Modern quantitative theories of water transport in plants can be traced to concepts developed and disseminated effectively in landmark papers by Gradmann and van den Honert in 1928 and 1948 respectively. The material reviewed in this paper, while more advanced, is based on these concepts. Emphasis is placed on water movement in soil containing roots and on a general approach to water transport in living plant tissue.
Detailed quantitative studies of water extraction by plant roots date back to studies by Gardner published in 1960. Many contemporary models are built around extraction functions in the Darcy-Richards equation. Several such functions are listed in Table 1, and their applications, relative advantages, and limitations are discussed in the text. In a series of papers published in 1958, Philip developed the first detailed quantitative description of water transport in plant tissue. His approach resulted in a diffusion equation which could be written with water potential as the dependent variable. Philip's derivation assumed that water movement was primarily from vacuole to vacuole. Subsequent workers have refined and extended Philip's development to include water movement in cell walls and plasmodesmata. The development, interpretation and application of these models over the past decade is presented in some detail. It can be argued that contemporary models of water transport in plant tissue are oversimplified. However, they have been subjected to some successful testing and they provide a framework within which to devise experiments. Moreover, the recent development of sophisticated experimental techniques should result in more detailed model testing during the 1980's.
Water Resour. Res., Paper 1W0911

3160 Runoff and streamflow
A MODEL OF DISCONTINUOUS MEASUREMENT ERROR AND ITS EFFECTS ON THE PROBABILITY DISTRIBUTION OF FLOOD DISCHARGE MEASUREMENTS
Kenneth W. Potter (Department of Civil and Environmental Engineering, University of Wisconsin, Madison, WI 53706) and John F. Walker
Above a given threshold an indirect method must be used to estimate flood discharges. This results in a significant increase in the standard deviation of the measurement error, a phenomenon which the authors have termed discontinuous measurement error (dme). An error model reveals that the coefficients of variation, skewness, and kurtosis of the distribution of the measured flood discharges are significantly higher than the corresponding coefficients of the parent flood distribution. This bias has important implications with regard to flood frequency analysis. (Flood frequency).
Water Resour. Res., Paper 1W0836

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Izvestiya Physics of the Solid Earth

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